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ABSTRACT

A computer assisted learning (CAL) program in the area of intravenous drug administration developed by the Nightingale Project is currently being used in a number of nursing schools and hospitals throughout the United Kingdom. The success of this program and the emergence of interactive video as a significant training medium persuaded the Nightingale Project to carry out a feasibility study into the requirements for a successful implementation of an interactive video for nursing education. This paper describes the various levels of detail involved in the design of the video, the knowledge elicitation procedures that were used, the range of teaching strategies employed, and the various problems encountered together with the solutions developed to overcome them. The aims of the feasibility study were to: (1) identify the range of different skills required to design interactive video courseware; (2) identify the resource implications in terms of staff time and hardware and software requirements; (3) assess the likely availability of skills within the nursing profession to carry out the design and implementation of such a project; and (4) determine the requirements for and cost of technical support from outside the profession. The need for a team approach to the design and development process involving subject matter experts and designers led by an educational systems analyst is highlighted. Task analysis charts and instructional design blueprints are included. (7 references) (GL)

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Design Considerations for the Development of Interactive Video (IV) in Nurse Education

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Abstract

Nurse education is one area which combines both a high level of technical skill and knowledge within a working environment in which inter-personal skills are vital. Thus it was considered appropriate to carry out a feasibility study on the use of Interactive Video in nurse education. The subject chosen was that of Intravenous Care because of the increasing evidence demonstrating both the hazards to the patient of poor practice and the poor knowledge base of practitioners, medical and nursing, in a climate of increasing technology and pharmacology associated with the intravenous route. The complexity of such a subject required a richness in the educational strategies employed in interacting with the video and the knowledge base within the computer. Furthermore, the need for independant validation of the content was essential in a development area that aimed to provide a high, if not national standard of care for a nursing procedure.

Developments in this area highlighted the need for a team approach to the design and development process involving subject experts and designers led by an educational systems analysts. This paper will outline the design methodology employed in a feasibility study for an interactive video program for the training and assessment of nurses in the care required by a patient receiving intravenous therapy and medication.

Introduction

The Nightingale Project[1] carried out a feasibility study on the design and an implementation of a Computer Assisted Learning (CAL) Program in the area of Intravenous Drug Administration. This program (BBC version) is currently being used in a number of schools of nursing and hospitals throughout the UK and an extensive evaluation of the program has been completed[2]. The evaluation has confirmed the essential success of the project in establishing the educational innovation of CAL in Nurse Education. This project has also contributed significantly to the thinking about the role of computers in Nurse Education and the English National Board has recently established a national CAL Project.

During the period of the project, the increasing availibility of IBM PCs resulted in the Nightingale Project developing an IBM Version[3] of the CAL package with funding from the DHSS. The emergence of Interactive Video as a significant training medium persuaded the Nightingale Project to carry out a feasibility study into the requirement for a successful implementation of an Interactive Video (IV) for Nurse Education. This paper will concentrate on the various levels of detail involved in the design, the knowledge elicitation procedures that were used, the range of teaching strategies employed, and the

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various problems encountered and the solutions developed to overcome them. The overall project planning and management (including the timescales, budgets, and production issues) of the feasibility study will be covered in a subsequent paper.

Aims & Methodology of the IV Feasibility Study

The aims of the study were :

- To identify the range of different skills required to design Interactive Video courseware.
- To identify the resource implications in terms of staff time, hardware and software requirements.
- To assess the likely availability of skills within the nursing profession to carry out the design and implementation, i.e. to establish if a skills shortage exists.
- To determine the requirements for technical support, and their costs, from outside the profession.

Building on the experience of the Nightingale Project, it was decided to use the same topic for the study viz: Intravenous Care. However, it was recognised that the nature of the Interactive Video medium provided an ideal environment for showing and discussing interpersonal skills within a real situation. It was therefore decided to provide a set of problem-solving scenarios in a real environment in the topic of Intravenous Care. The title for the study was chosen to reflect this thinking: "Interactive Video for Intravenous Care". The theme being not just safe practice as in the case of the Nightingale Project but care and maintenance of the Intravenous Site and patient.

It was decided that a global design of the complete IV package should be carried out together with a detailed design of some sections of the package. The detailed design required a comprehensive plan of computer presentations, video presentations (sequences) and learner-computer interactions structured into a completely documented design showing all possible routings for the learner. Detailed examples of computer presentations and video sequences needed to be written by subject experts and technical advisers and needed to be sufficient in number to provide a large enough sample from which to extrapolate the requirements for the whole package. In addition to the resource requirements for design, the programming and filming (video recording) requirements could then be estimated together with other resource issues that might emerge, but not anticipated, at the outset of the study. The Team Approach to courseware development was adopted[4].

Global Design

The Global Design evolved over a period of time and involved two different nurse tutors at different times in the role of designer. This lack of continuity occurred at a time when there were significant changes taking place in Nurse Education and this resulted in significant changes to the Global Design. In both cases, the designer took subject specialist advice from colleagues in an Intravenous Team and other professionals in the field to ensure that a high and national standard was determined at the outset. It should be noted that in one case, the subject specialist was located at a different hospital, whilst the subject specialist was in another, was available for only 50% of the time, and was under extreme pressure of work as an Intravenous Team Leader in which there was a persistent staff shortage due to the skill shortage in this highly specialised area. These two factors, taken together with the limited time available of the designer, prolonged the development of the global design to a period of nine months.

The global design is outlined as a chart in Figure 1. It can be seen that the global design involved an introduction and 7 other sections (organised as 8 scenes).

Detailed Design

The nature of the design process involved detailed discussions and design decisions between nurse-tutor designer and the various members of the team viz: Subject Experts, Educational Systems Analyst, Programmer, Script Writer and Video Consultant. The result of all design decisions had to be documented in such a way as to be intelligible to all members of the team and that such documents form the basis of the subsequent discussion that took place after an intervening period of time - typically 1 to 2 weeks.

The design documentation process had to clearly show the interaction between the learner and the computer, and the learner and the video. This had to be in sufficient detail so as to ensure that the programmer implemented the whole system as specified by the plan. Several CBT tools were adapted to assist in the detailed design[5]. Such detailed refinement of the design is illustrated in Figure 2 in which 4 levels of design are illustrated. Levels 1 - 3 are machine and programming language independant, while Level 4 is machine dependant i.e. the computer code flowchart. These figures illustrate the detail, scale and extent of such a design task. Each of the sequences indicated are either a number of computer screens with text and graphics or a video sequence. The detail of each such sequence had therefore to be written in full by the nurse tutor or by the script writer in close association with the tutor. This represented a significant task and use of resources.

Figure 1

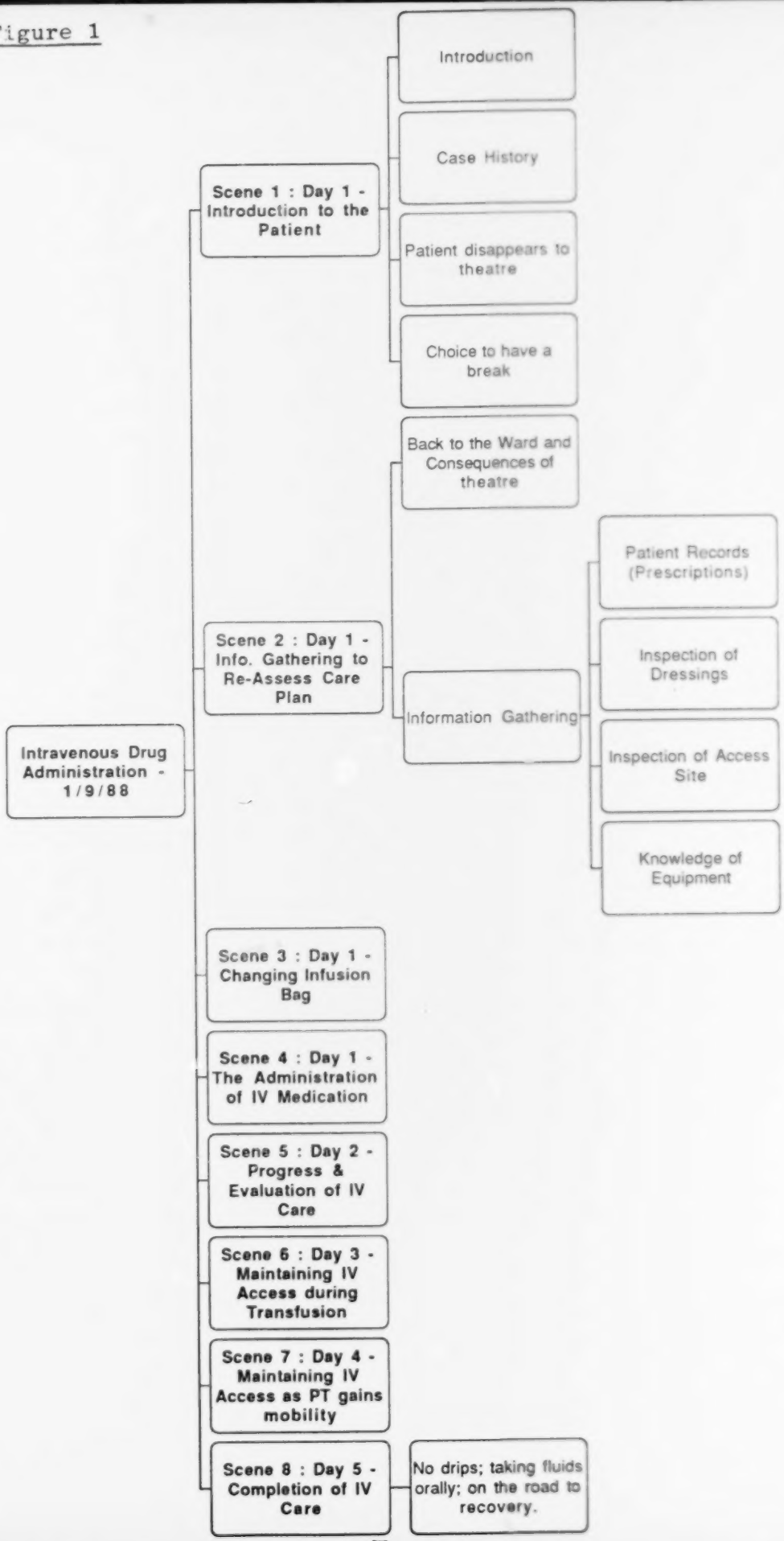

Intravenous Drug Administration - 1/9/88
Scene 1 : Day 1 - Introduction to the Patient
Introduction
Case History
Patient disappears to theatre
Choice to have a break
Scene 2 : Day 1 - Info. Gathering to Re-Assess Care Plan
Back to the Ward and Consequences of theatre
Information Gathering
Patient Records (Prescriptions)
Inspection of Dressings
Inspection of Access Site
Knowledge of Equipment
Scene 3 : Day 1 - Changing Infusion Bag
Scene 4 : Day 1 - The Administration of IV Medication
Scene 5 : Day 2 - Progress & Evaluation of IV Care
Scene 6 : Day 3 - Maintaining IV Access during Transfusion
Scene 7 : Day 4 - Maintaining IV Access as PT gains mobility
Scene 8 : Day 5 - Completion of IV Care
No drips; taking fluids orally; on the road to recovery.

Figure 2i - Level1

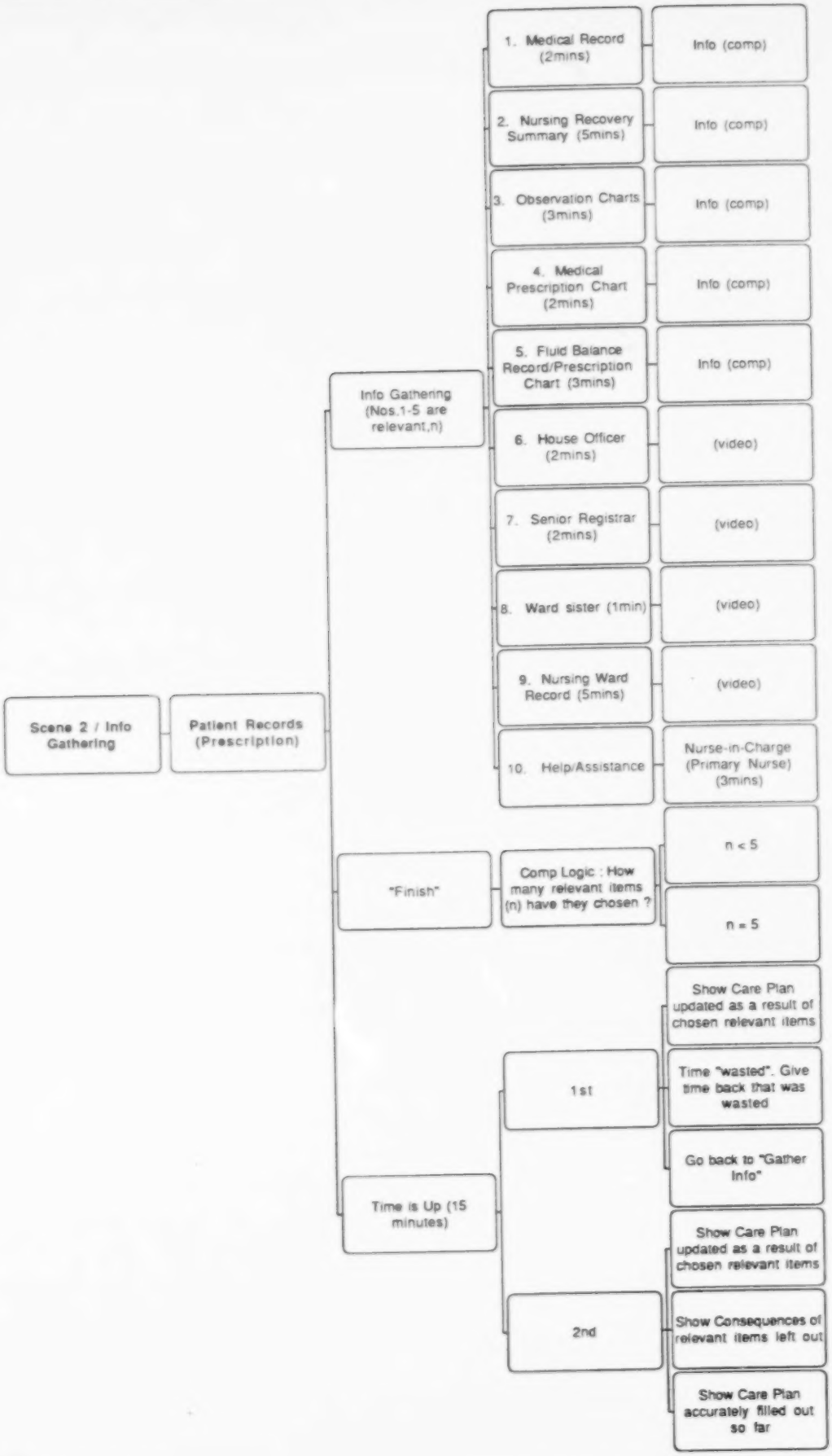

Scene 2 / Info Gathering
Patient Records (Prescription)
Info Gathering (Nos.1-5 are relevant,n)
1. Medical Record (2mins)
Info (comp)
2. Nursing Recovery Summary (5mins)
Info (comp)
3. Observation Charts (3mins)
Info (comp)
4. Medical Prescription Chart (2mins)
Info (comp)
5. Fluid Balance Record/Prescription Chart (3mins)
Info (comp)
6. House Officer (2mins)
(video)
7. Senior Registrar (2mins)
(video)
8. Ward sister (1min)
(video)
9. Nursing Ward Record (5mins)
(video)
10. Help/Assistance
Nurse-in-Charge (Primary Nurse) (3mins)
"Finish"
Comp Logic : How many relevant items (n) have they chosen ?
n < 5
n = 5
Time is Up (15 minutes)
1st
Show Care Plan updated as a result of chosen relevant items
Time "wasted". Give time back that was wasted
Go back to "Gather Info"
2nd
Show Care Plan updated as a result of chosen relevant items
Show Consequences of relevant items left out
Show Care Plan accurately filled out so far

Figure 2ii - Level2

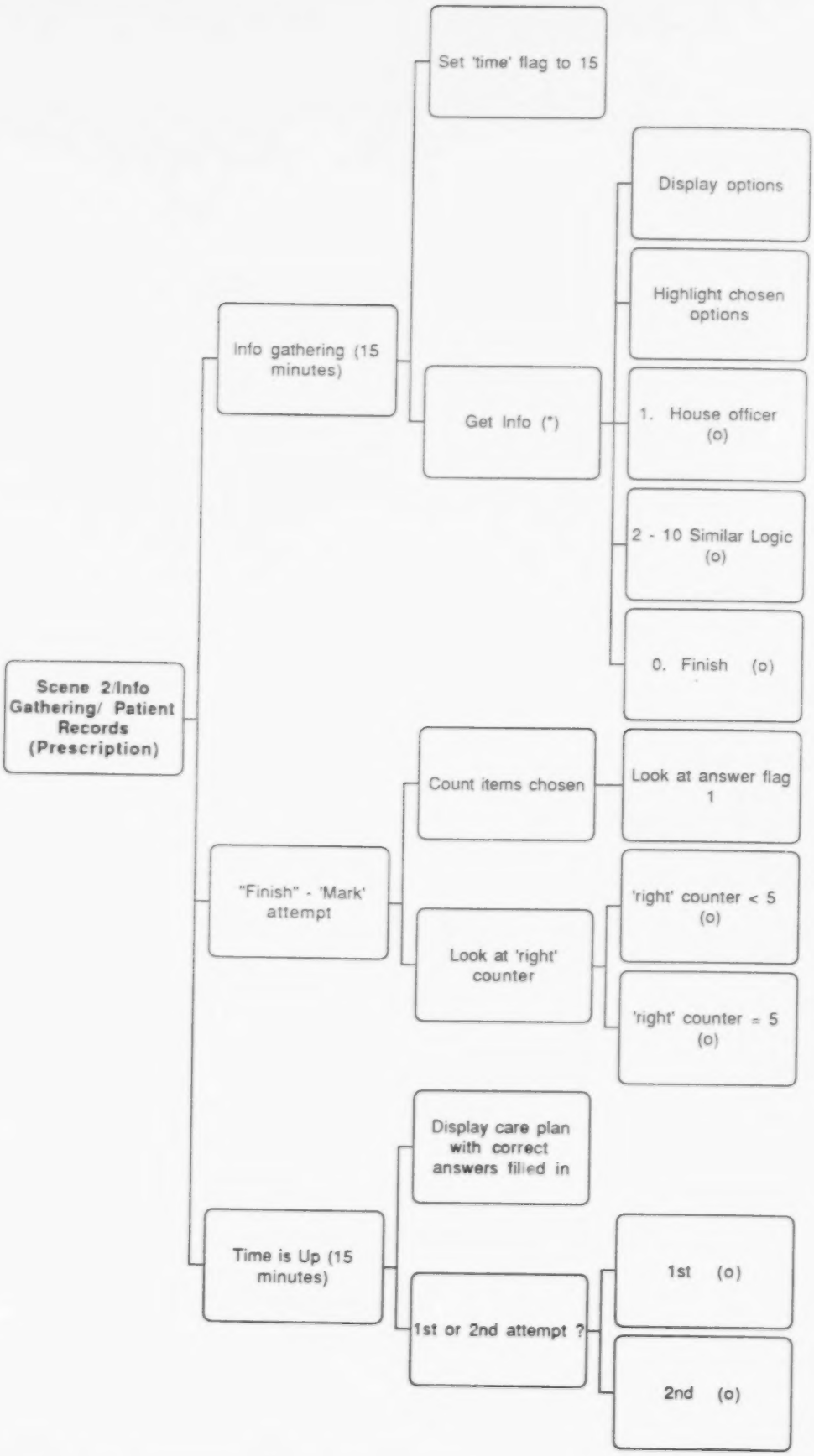

Scene 2/Info Gathering/ Patient Records (Prescription)
Info gathering (15 minutes)
Set 'time' flag to 15
Get Info (*)
Display options
Highlight chosen options
1. House officer (o)
2 - 10 Similar Logic (o)
0. Finish (o)
"Finish" - 'Mark' attempt
Count items chosen
Look at answer flag 1
Look at 'right' counter
'right' counter < 5 (o)
'right' counter = 5 (o)
Time is Up (15 minutes)
Display care plan with correct answers filled in
1st or 2nd attempt ?
1st (o)
2nd (o)

Figure 2iii - Level3

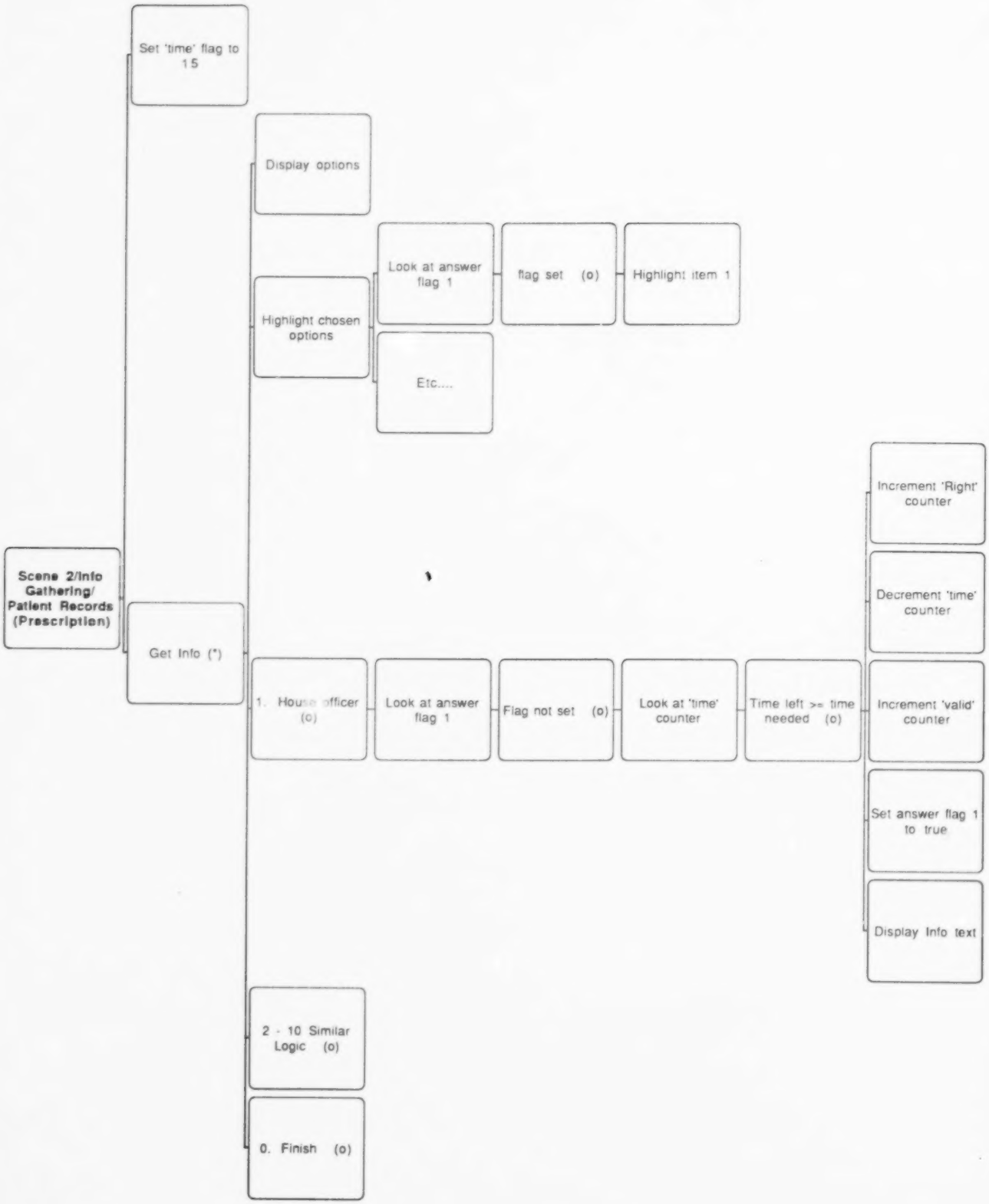
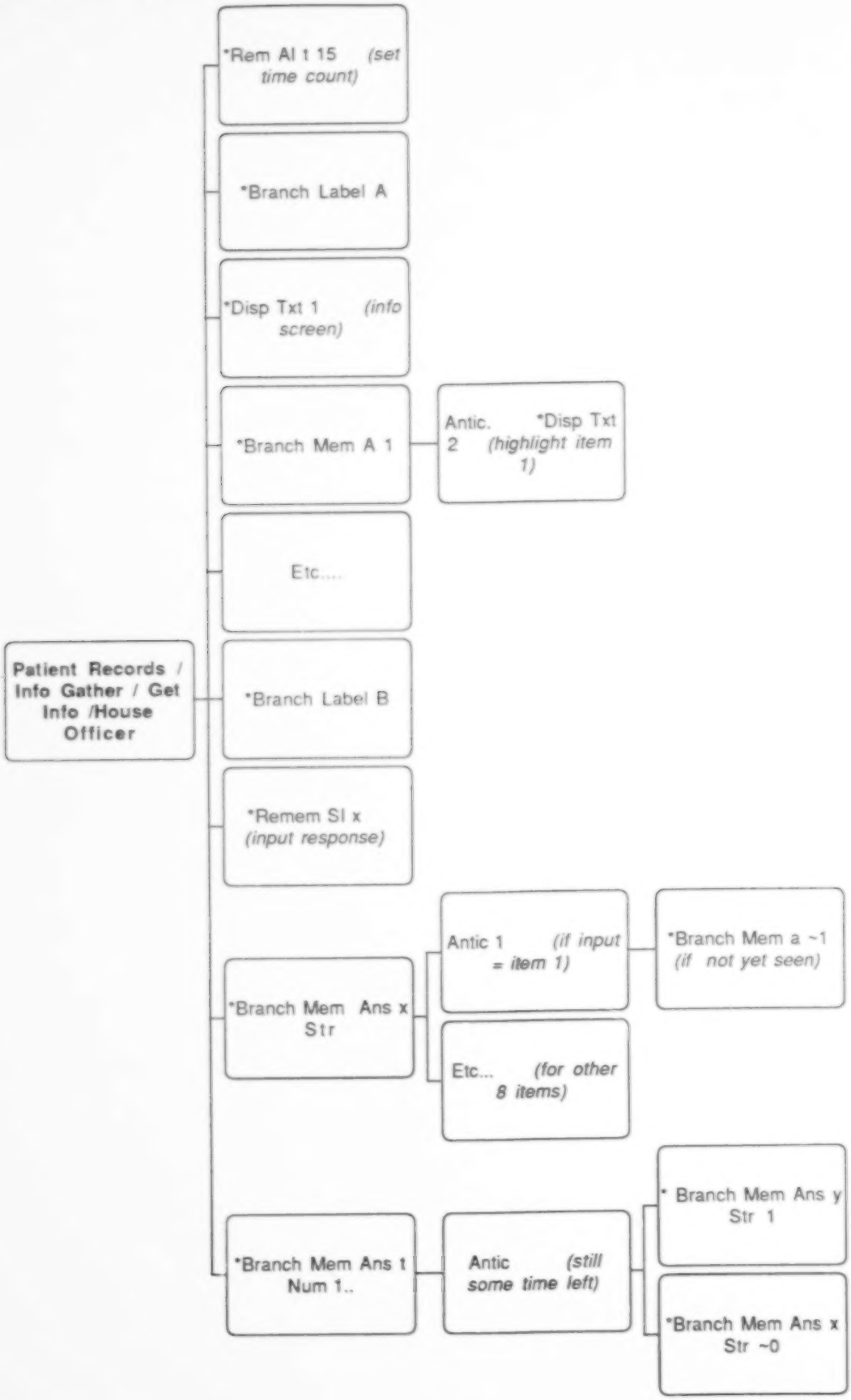


Figure 2iv - Level4


Patient Records / Info Gather / Get Info /House Officer
*Rem Al t 15 (set time count)
*Branch Label A
*Disp Txt 1 (info screen)
*Branch Mem A 1
Antic. *Disp Txt 2 (highlight item 1)
Etc....
*Branch Label B
*Remem Sl x (input response)
*Branch Mem Ans x Str
Antic 1 (if input = item 1)
*Branch Mem a ~1 (if not yet seen)
Etc... (for other 8 items)
*Branch Mem Ans t Num 1..
Antic (still some time left)
* Branch Mem Ans y Str 1
*Branch Mem Ans x Str ~0

Until the Script Writer had completed his/her task, it was not possible to obtain an accurate estimate of the requirements necessary for shooting the video. Of particular significance was the requirement for a large number of video sequences, often self-contained, for an Interactive Video program, as opposed to a continuous conventional video recording. For example, the interactive video presented a short sequence to the learner terminated by the request for interaction from the learner. That interaction will, in general, cause one of many possible video sequences to be shown. Thus, the 35 minutes of one side of an interactive disc could be made up of as many as 200 sequences varying in duration from 3 seconds to 45 seconds. The planning of such video materials is significantly different from conventional video and few producers have much experience in this area.

Teaching Strategies Employed

Another important emphasis of the design was to provide **meaningful interactivity** for the learner. Meaningful interaction occurs when the learner has to **process** some information to work out the correct answer(s), and then input his response to the system. Pressing the RETURN or SPACEBAR key repeatedly to display new text or graphics does not constitute meaningful interaction.

The identification and definition of the knowledge and skills needed to carry out the task of safe intravenous care required very careful and detailed elicitation from the nurse tutor/subject expert. Not all learning is a simple matter of knowledge retention - determining the level of learning required was therefore crucial to the design of the courseware. Gagné's categorisation of the five varieties of learning[6] - Motor Skills, Attitudes, Verbal Information, Intellectual Skills and Cognitive Strategies and his classification scheme of nine instructional events[7] (i.e. nine distinct and identifiable events that enhance learning when included in learning situations) provided a basis for identifying these training needs and the foundation by which appropriate teaching strategies could be devised for the courseware. The nine instructional events identified by Gagné are:

1. Gaining attention
2. Informing learner of objectives
3. Stimulating recall of pre-requisites
4. Presenting stimulus material
5. Providing "learner guidance"
6. Eliciting the performance
7. Providing feedback
8. Assessing the performance

9. Enhancing retention and transfer

These teaching strategies which were devised on the matrix of the varieties of learning (except Motor Skills) and the instructional events, provided a structure from which "meaningful interaction" for the learner could occur. Examples of how these were achieved are provided below. In all of these examples,

- The interactive video was used to provide immediate feedback (either as computer text screens, audio tracks, or short video sequences), to assess and show the consequences of any actions left out, and to show or demonstrate correct action taken (also by a set of computer text screens, audio tracks, or short video sequences).
- The notion of a computer Care Plan (i.e. a record providing an account of the nurses' assessment, planning and evaluation of care) was introduced. This provided an on-going feedback to the learner as to the results and consequences to the care of the patient throughout the entire interactive video courseware.
- At any time, the learner was able to access a list of structure and process criteria statements for safe and professional nursing practise.
- By the use of menus, the learner was able to enter at the beginning of any scene or sub-scene, although he/she was strongly advised to start from the beginning and to proceed to the end sequentially. At the end of every scene or sub-scene, the opportunity was provided for the learner to continue or to stop and resume where he/she had left off.

Example 1 (Figure 3)

- The **identification** of essential information sources
- The **interpretation** of the information gathered as a result of what information sources were identified

The learner was required to select 5 (out of 10) sources of information that would enable him to correctly update the Patient's nursing record. The learner was provided with a simulated time limit of 15 minutes, with each information source "consuming" a certain amount of time. The learner could identify any information source in any order. Two chances (of 15 minutes simulated time) were provided.

The interactive video was used to provide the information sources (either as computer text screens or short video sequences), and to assess and to show the consequences of any relevant information sources left out.

Example 2 (Figure 4)

- **Observation & selection** from an item bank
- **Classification** of a set of criteria
- **Formulation** of a matrix - criteria vs. items
- **Comparison & inference** based on learner's matrix with computer's matrix
- **Measuring** the selection

Based on the learner's professional judgement, he/she was required to select an appropriate dressing (out of a choice of 4). The learner was then presented with a list of 13 criteria statements for the selection of a suitable dressing, and was requested to "band" these criteria into "preferable" and "questionable". If the learner's banding corresponded with the computer's model, a video rationale would be presented. If the banding did not correspond, the computer's model would be presented and the differences highlighted with justification.

The learner would then be presented with a blank matrix of the 4 dressings with the 9 "preferable" criteria statements. The learner would then be asked to fill in the matrix with a 'Yes' or a 'No' as to whether each dressing satisfied each of the criteria. In this way, the learner would be encouraged to see the 'rationale' of the selection of a particular dressing. The learner's matrix would then be compared with the computer's matrix with a feedback video sequence shown whenever a mismatch occured for each criteria. If the learner's choice of a dressing was different to that of the computer model, the learner would be given the opportunity to re-select, and an appropriate video feedback provided if the selection again differed.

Example 3 (Figure 5)

- **Identification** of inappropriate skills employed - spot the mistake !
- **Identification** of appropriate skills employed

The learner was first primed to think on the necessary skills required (observational, interpersonal and interpreting skills) in assessing an access site. Two approaches on accessing sites was then shown with the learner being asked to identify the most appropriate approach.

If the incorrect approach was selected, the video sequence would be re-displayed and the learner requested to stop the video whenever an inappropriate action (10 in total) was identified. If an inappropriate action was identified, a rationale of why the action was inappropriate was shown, highlighting the incorrect skills employed. At the end of the

video sequence, any inappropriate actions not "spotted" by the learner would then be displayed again with the rationale given.

A similar strategy was used if the learner selected the correct approach. This time he/she would have to identify the correct actions carried out with the rationale of the correct skills employed provided. Thus, a positive approach and feedback was also encouraged.

Example 4 (Figure 6)

- **Predicting** the consequences of decisions made and actions taken
- **Measuring** the cumulative repercussions of decisons made

The learner was provided with a set of 3 different actions to be taken under three seperate categories of patient comfort, knowledge and progress. For each category, the learner was requested to select the appropriate action to be taken that will minimise patient anxiety, increase safe IV practice, ensure continuity of care - all reflecting the learner's appreciation of the patient situation.

The learner would thus have to consider the action to be taken and predict & measure the cumulative consequences of such actions taken with respect to the above criteria. Feedback was provided by means of cumulative graphs and bar charts showing the effect of the actions taken.

Apart from these teaching strategies, other more common strategies of multiple-choice questions, true/false techniques, and simple open-ended questions were also included in the interactive video courseware.

Figure 3

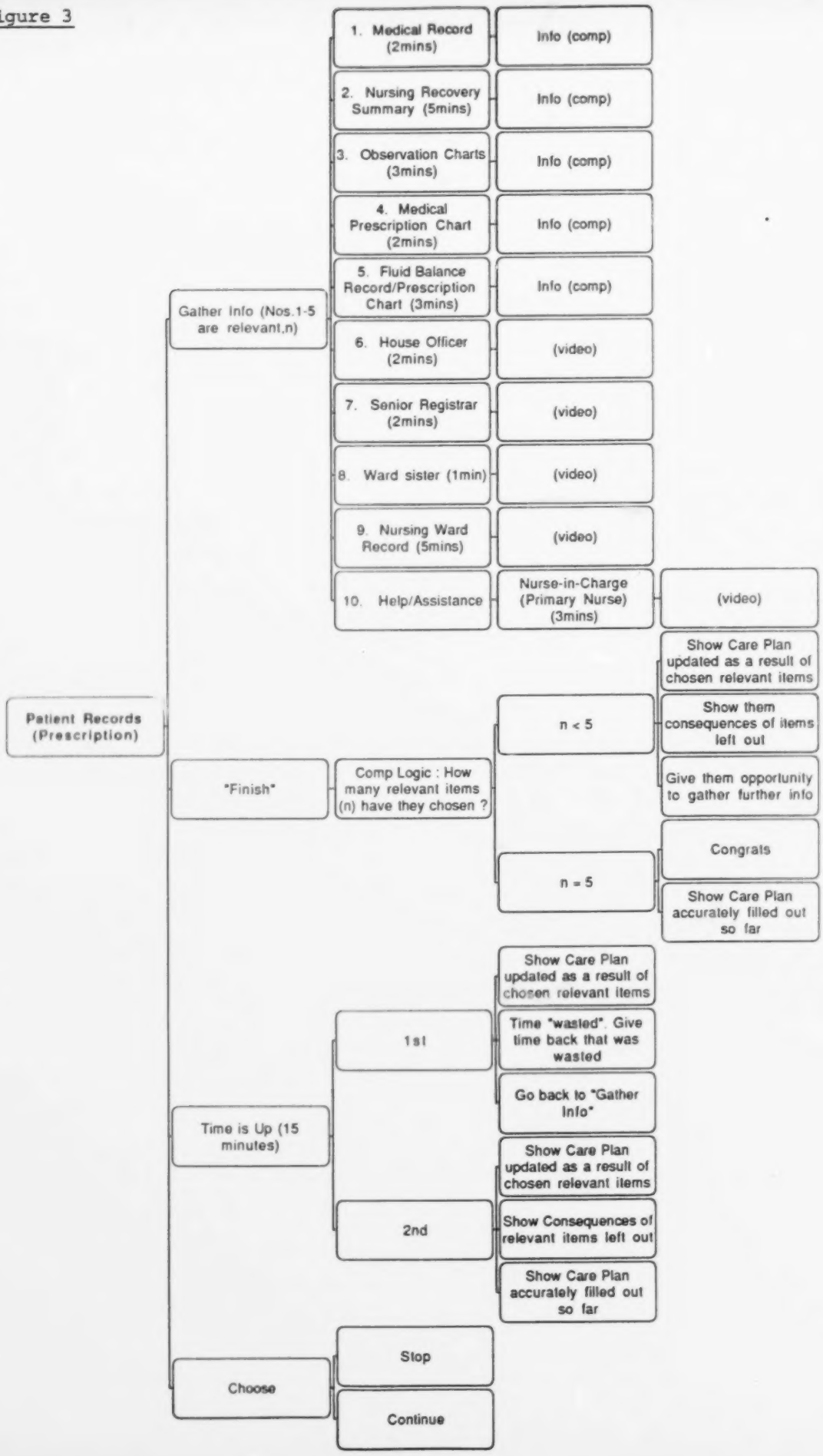

Patient Records (Prescription)
Gather Info (Nos.1-5 are relevant,n)
1. Medical Record (2mins)
Info (comp)
2. Nursing Recovery Summary (5mins)
Info (comp)
3. Observation Charts (3mins)
Info (comp)
4. Medical Prescription Chart (2mins)
Info (comp)
5. Fluid Balance Record/Prescription Chart (3mins)
Info (comp)
6. House Officer (2mins)
(video)
7. Senior Registrar (2mins)
(video)
8. Ward sister (1min)
(video)
9. Nursing Ward Record (5mins)
(video)
10. Help/Assistance
Nurse-in-Charge (Primary Nurse) (3mins)
(video)
"Finish"
Comp Logic : How many relevant items (n) have they chosen ?
n < 5
Show Care Plan updated as a result of chosen relevant items
Show them consequences of items left out
Give them opportunity to gather further info
n = 5
Congrats
Show Care Plan accurately filled out so far
Time is Up (15 minutes)
1st
Show Care Plan updated as a result of chosen relevant items
Time "wasted". Give time back that was wasted
Go back to "Gather Info"
2nd
Show Care Plan updated as a result of chosen relevant items
Show Consequences of relevant items left out
Show Care Plan accurately filled out so far
Choose
Stop
Continue

Figure 4

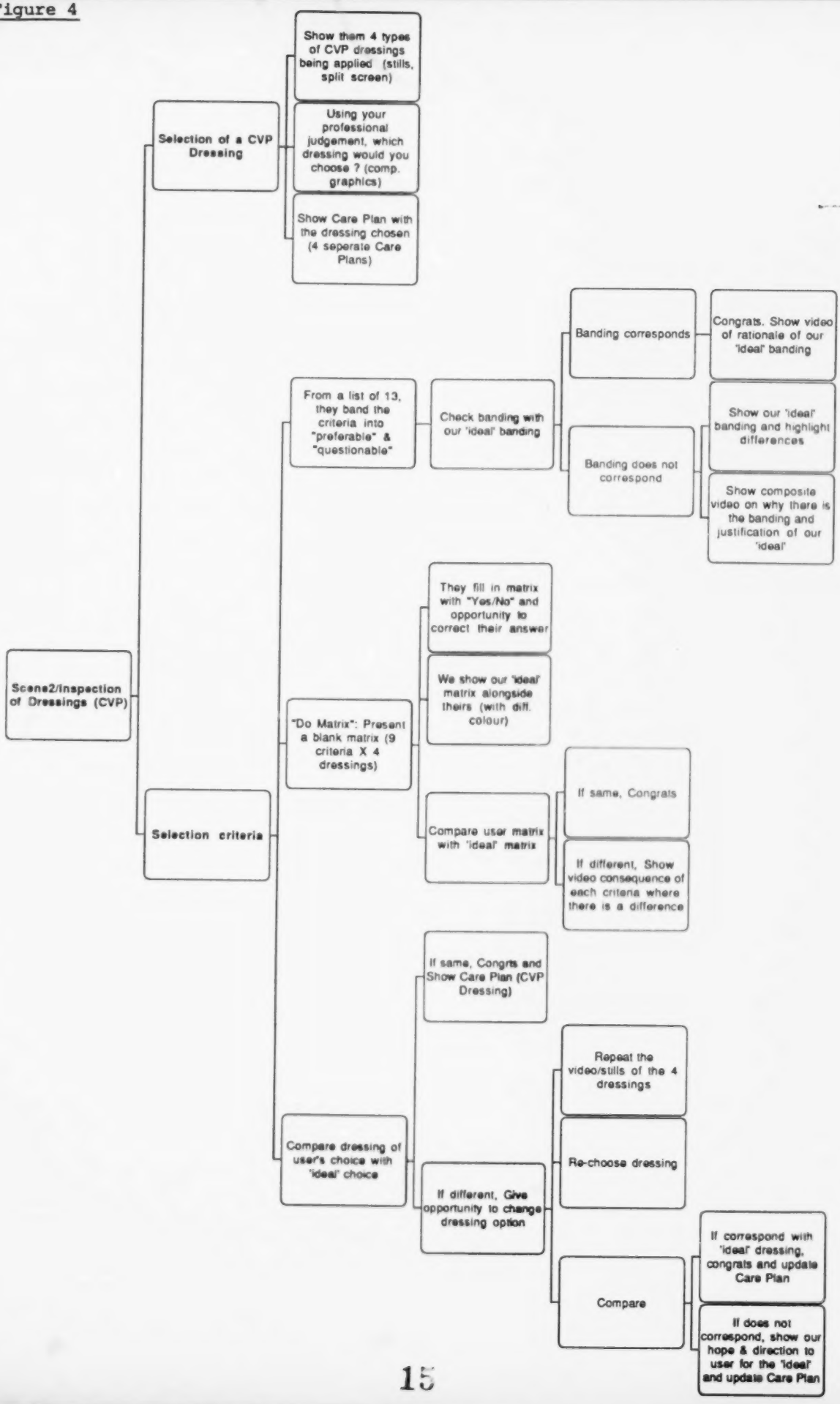

Scene2/Inspection of Dressings (CVP)
Selection of a CVP Dressing
Show them 4 types of CVP dressings being applied (stills, split screen)
Using your professional judgement, which dressing would you choose ? (comp. graphics)
Show Care Plan with the dressing chosen (4 seperate Care Plans)
Selection criteria
From a list of 13, they band the criteria into "preferable" & "questionable"
Check banding with our 'ideal' banding
Banding corresponds
Congrats. Show video of rationale of our 'ideal' banding
Banding does not correspond
Show our 'ideal' banding and highlight differences
Show composite video on why there is the banding and justification of our 'ideal'
"Do Matrix": Present a blank matrix (9 criteria X 4 dressings)
They fill in matrix with "Yes/No" and opportunity to correct their answer
We show our 'ideal' matrix alongside theirs (with diff. colour)
Compare user matrix with 'ideal' matrix
If same, Congrats
If different, Show video consequence of each criteria where there is a difference
Compare dressing of user's choice with 'ideal' choice
If same, Congrts and Show Care Plan (CVP Dressing)
If different, Give opportunity to change dressing option
Repeat the video/stills of the 4 dressings
Re-choose dressing
Compare
If correspond with 'ideal' dressing, congrats and update Care Plan
If does not correspond, show our hope & direction to user for the 'ideal' and update Care Plan

Figure 5

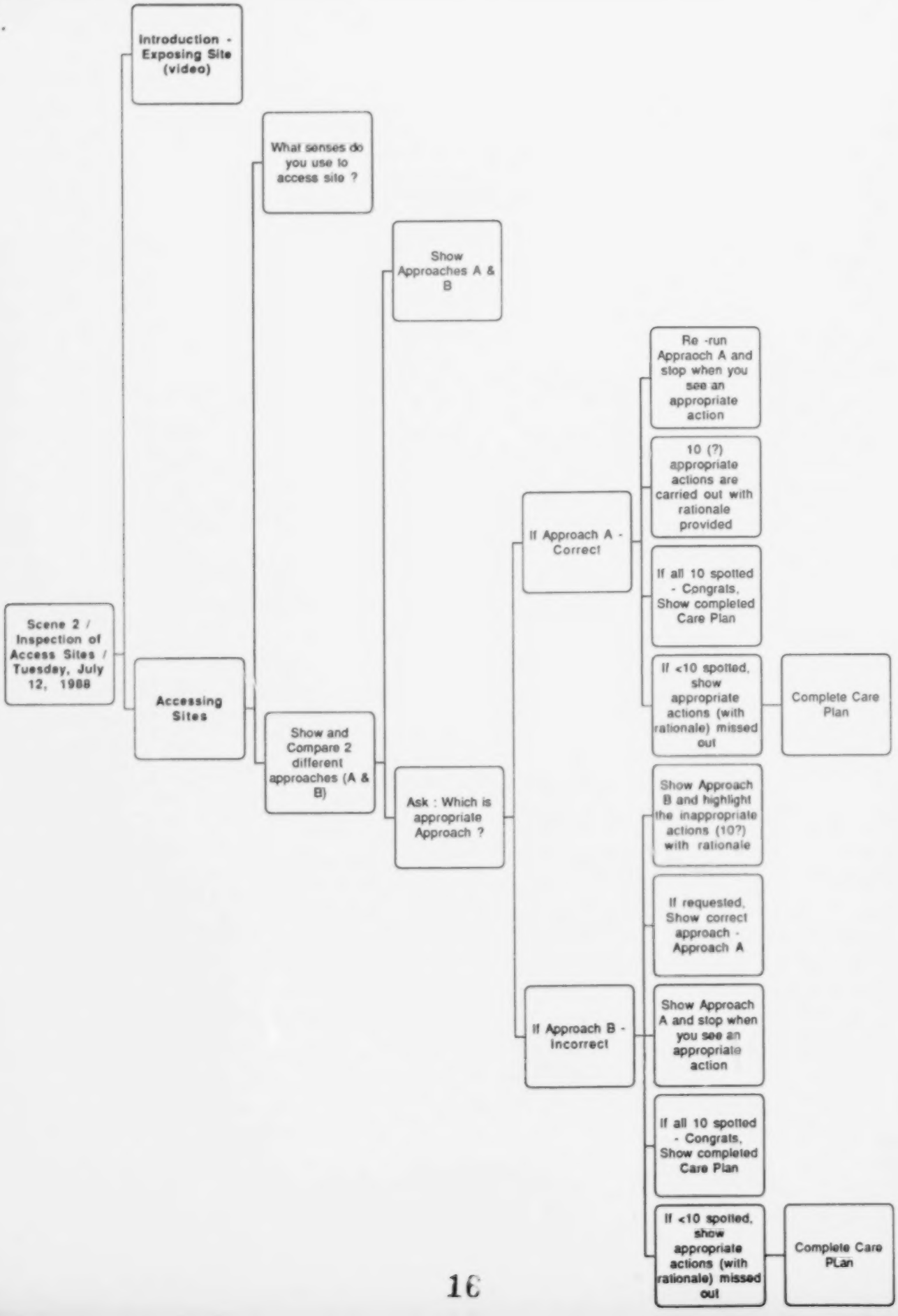
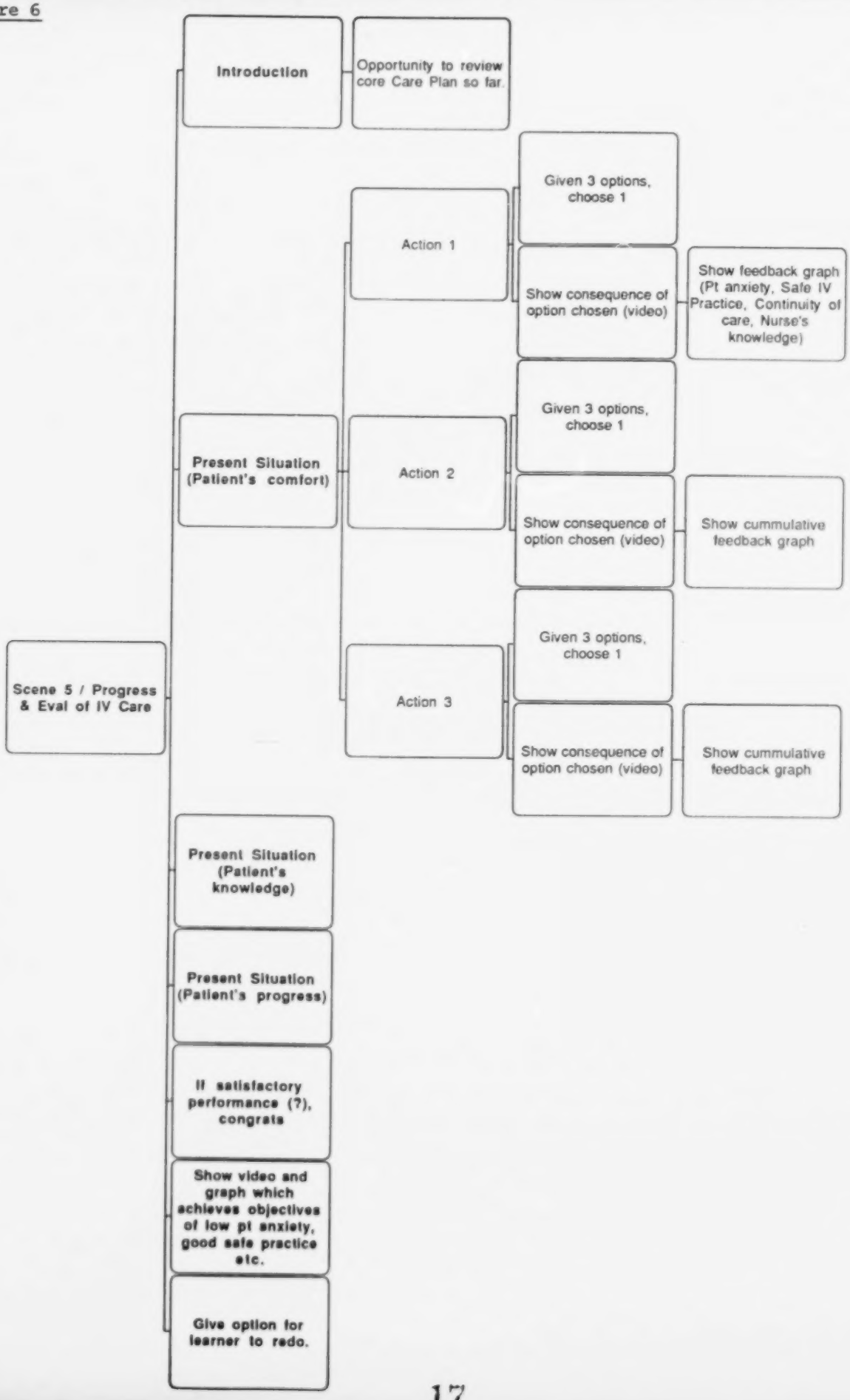

Scene 2 / Inspection of Access Sites / Tuesday, July 12, 1988
Introduction - Exposing Site (video)
Accessing Sites
What senses do you use to access site ?
Show and Compare 2 different approaches (A & B)
Show Approaches A & B
Ask : Which is appropriate Approach ?
If Approach A - Correct
Re -run Appraoch A and stop when you see an appropriate action
10 (?) appropriate actions are carried out with rationale provided
If all 10 spotted - Congrats, Show completed Care Plan
If <10 spotted, show appropriate actions (with rationale) missed out
Complete Care Plan
If Approach B - Incorrect
Show Approach B and highlight the inappropriate actions (10?) with rationale
If requested, Show correct approach - Approach A
Show Approach A and stop when you see an appropriate action
If all 10 spotted - Congrats, Show completed Care Plan
If <10 spotted, show appropriate actions (with rationale) missed out
Complete Care PLan

Figure 6


Scene 5 / Progress & Eval of IV Care
Introduction
Opportunity to review core Care Plan so far.
Present Situation (Patient's comfort)
Action 1
Given 3 options, choose 1
Show consequence of option chosen (video)
Show feedback graph (Pt anxiety, Safe IV Practice, Continuity of care, Nurse's knowledge)
Action 2
Given 3 options, choose 1
Show consequence of option chosen (video)
Show cummulative feedback graph
Action 3
Given 3 options, choose 1
Show consequence of option chosen (video)
Show cummulative feedback graph
Present Situation (Patient's knowledge)
Present Situation (Patient's progress)
If satisfactory performance (?), congrats
Show video and graph which achieves objectives of low pt anxiety, good safe practice etc.
Give option for learner to redo.

Conclusion

The use of Interactive Video for training in an environment involving inter-personal skills is recognised to be a valuable educational learning aid. In addition, the computer which is used to control the interaction can also provide support for a wide range of styles of learning - in the same way as occurs in Computer Assisted Learning and Computer Based Training.

In the area of Intravenous Care, there was a requirement for a high level of acceptable and accurate detailed knowledge which must be elicitated from subject experts if the content were to be accepted by the professionals. In addition, the complexity of the subject required a very rich environment of educational strategies to be employed. These various requirements imposed a very large effort and detail on the design and development of the interactive courseware in nurse education.

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